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King Abdullah University of Science and Technology
Thuwal, Kingdom of Saudi Arabia

The المنارة Beacon

www.kaust.edu.sa

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In brief

Enrichment in the Fall (FEP) 2015 begins on **Friday, October 16.** The theme is "Large Marine Animals on the Move," and is inspired by work from KAUST's Red Sea Research Center. An **opening night extravaganza will be held** on **Sunday, October 18**. FEP 2015 will include marine-themed movies, a visit to King Abdullah Economic City's port, a Jeddah aquarium trip and a live musical performance by **Grammy-winning artist Paul Winter.** More information can be found at **http://fep.kaust.edu.sa/Pages/Events.aspx.**

Some of the world's most eminent experts on marine megafauna will attend the **KAUST Marine Megafauna Movement Workshop** on **Tuesday, October 19 and Wednesday, October 20**. The workshop will be the center effort of the FEP 2015 program. Topics covered will include discovering how large marine megafauna move in the ocean through the use of new analytical and visualization tools. The event is organized by Professor Carlos M. Duarte and Assistant Professor Xiangliang Zhang, with financial support provided by KAUST's Office of Sponsored Research.

The second Sci-Café of the fall will take place **Wednesday, October 21 from 5:30 to 7:00 in the University Library.** The theme for the event is "How do we research the Red Sea." Professors Christian Voolstra, Michael Beruman and Burton Jones are the featured panelists. A third Sci-Café will take place in December. Stay tuned to The Lens for more information—**thelens@kaust.edu.sa.**

Innovation and Economic Development (I&ED) welcomes the entire KAUST community to learn about how I&ED supports inventors, entrepreneurs and industry. A **two-day open house** will run on **Monday, October 26 and Tuesday, October 27 from 9:30 a.m. to 3:00 p.m.** on the ground floor of Innovation Cluster 3 (bldg. 24). Light snacks and beverages will be served. Bring your KAUST ID for a chance to win an iPad Air.

The **Partners for Learning (PFL) program** from The KAUST School will offer a session on **Wednesday, October 28.** PFL keeps parents informed and involved in their children's education at KAUST. For more information, please visit **tks.kaust.edu.sa.**

The Office of the Arts invites the KAUST community to a performance on **Thursday, October 29** in the **Auditorium (bldg. 20)** by Jaein Yoo and her duet partner, vocalist Justyna Kabala Zanni. School-age children are encouraged to attend with parents. Light refreshments will be served from **7:00 p.m.**

The Solar Future 2015 Symposium will take place from **Saturday, November 7 to Wednesday, November 11** in the Conference Center (bldg. 19). The event will combine both emerging and mature technologies that will pave the way to the future of solar energy at high-efficiency and low cost. Twenty institutions from across Europe, the U.S. and Asia will be in attendance, including the U.S. National Laboratories (NREL, LANL), government-funded institutions (IMEC, HZB, ZSW) and prestigious universities such as Stanford, Princeton, MIT and EPFL, all with core competencies in energy and solar photovoltaics. For more information, visit **https://sperc.kaust.edu.sa/workshop.**

The **U.S. National Academy of Sciences 3rd Arab-American Frontiers Symposium U.S. NAS-KAUST Frontiers of Sensor Science Symposium** will be held on **December 5, 6 and 7.** The event will assemble U.S. and Arab scientists, engineers and medical professionals to discuss major scientific advances. A wide array of topics will be covered under the overarching theme of "Sensing Technologies, Networks and Applications," and the event will facilitate scientific exchange and dialog between researchers in Arab countries and in the U.S.●

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Accolades

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1. Dr. Pierre Magistretti, distinguished professor of Bioscience and dean of the Biological and Environmental Science Division.

Magistretti honored by IPSEN

Dr. Pierre Magistretti, distinguished professor of bioscience and dean of the Biological and Environmental Science Division, has been awarded the 2016 Fondation IPSEN Neuronal Plasticity prize for contributions to the field of neuroenergetics.

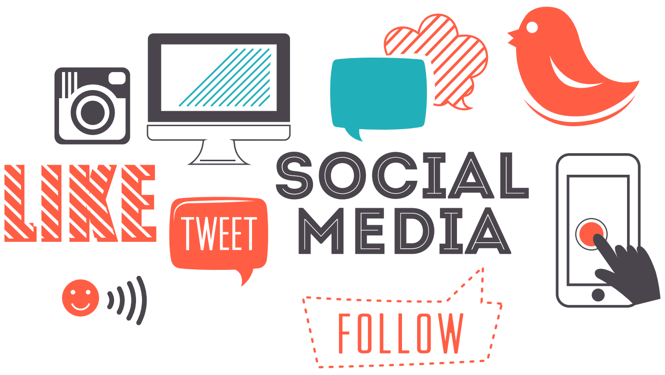
Magistretti accepts the award with co-recipients Dr. David Attwell of University College London and Dr. Marcus Raichle from Washington University. They will be honored at an award symposium on July 5, 2016 during the 10th Federation of European Neurosciences Societies (FENS) Forum in Copenhagen, Denmark.

"Pierre's significant contributions in brain-energy metabolism have resulted in significant new knowledge in neuroscience," said KAUST President Jean-Lou Chameau. "As an academic leader and passionate scientist, Pierre's research is helping transform our understanding of the brain—not only for the sake of scientific research, but also to benefit society." ●

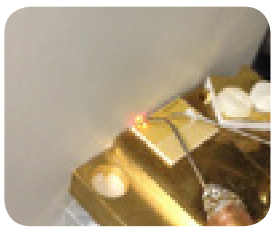
KAUST professor **wins University of Texas award**

Muhammad Mustafa Hussain, KAUST associate professor of Electrical Engineering, won a 2015 Outstanding Young Texas Exes (OYTEX) Award from The University of Texas at Austin (U.S.). The award recognizes University of Texas (UT) graduates (called "Texas Exes") age 39 and younger who have made outstanding achievements in their fields of work.

Hussain studied at UT from 2003-2005, completing both his master's degree and Ph.D. in solid state electronics within the area of electrical and computer engineering there. Upon joining KAUST in 2009, Hussain founded the University's Integrated Nanotechnology Laboratory, where he currently supervises 14 Ph.D. students. ●

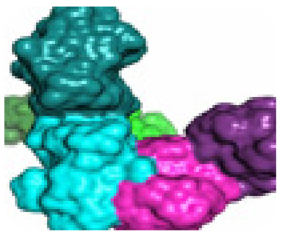


Here's a roundup of KAUSTcontent you shouldn't miss.



On KAUST Discovery – Changes to the composition of semiconductor structure enable laser light at colors not thought possible, reveal KAUST scientists. **http://goo.gl/btVE9Q**

On KAUST News – KAUST and fellows from NASA's Langley Research Center collaborated to launch six weather balloons from KAUST's Coastal & Marine Laboratory. Collaborators for the project also included the Saudi General Authority of Civil Aviation and Jeddah's King Abdulaziz International Airport. **http://goo.gl/WJY2RZ**



On KAUST Discovery – Novel anti-cancer drugs could result from collaborative research into a key cancer protein by researchers from KAUST and MD Anderson Cancer center. **http://goo.gl/Ma2lDB**

On KAUST Official - Follow KAUST on Facebook to see Professor Georgiy L. Stenchikov talk about KAUST's collaboration with NASA's Langley Research Center to launch six weather balloons and much more. **https://goo.gl/MXzVII** ●

Red Sea Facts

We live on the shores of the Red Sea, but how much do we really know about this body of water? We depend on it for water and seafood, it affects our local climate and it's where we go on the weekends for recreation.

Here are some fun facts you might not know about the waters right outside KAUST's doorstep.

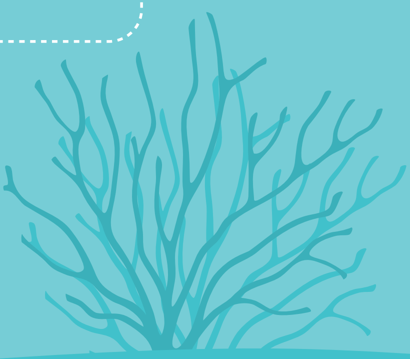
Also known as the
Erythaean Sea

Is **bordered by six countries**:
Saudi Arabia, Yemen, Egypt, Sudan, Eritrea and Djibouti

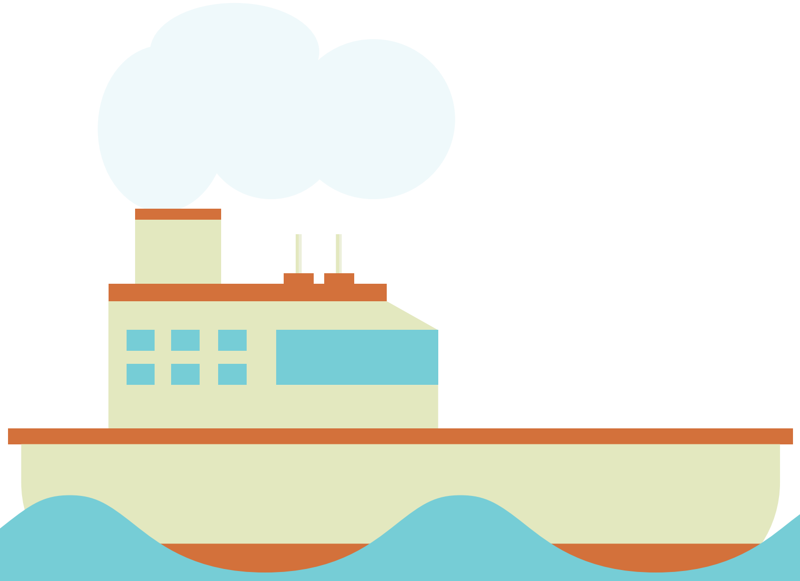
Is considered an
inlet of the Indian Ocean

Can fit into the
Pacific Ocean
more than **376 times**

Has over **25** verified
islands



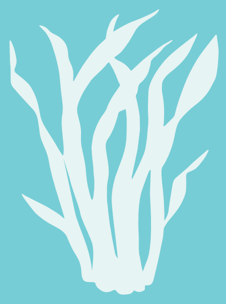
Reaches
2,500 m
in depth



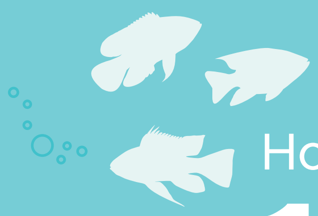
Has a **surface area** of
438,000
square kilometers

Contains approximately
2,000 km
of coral reef

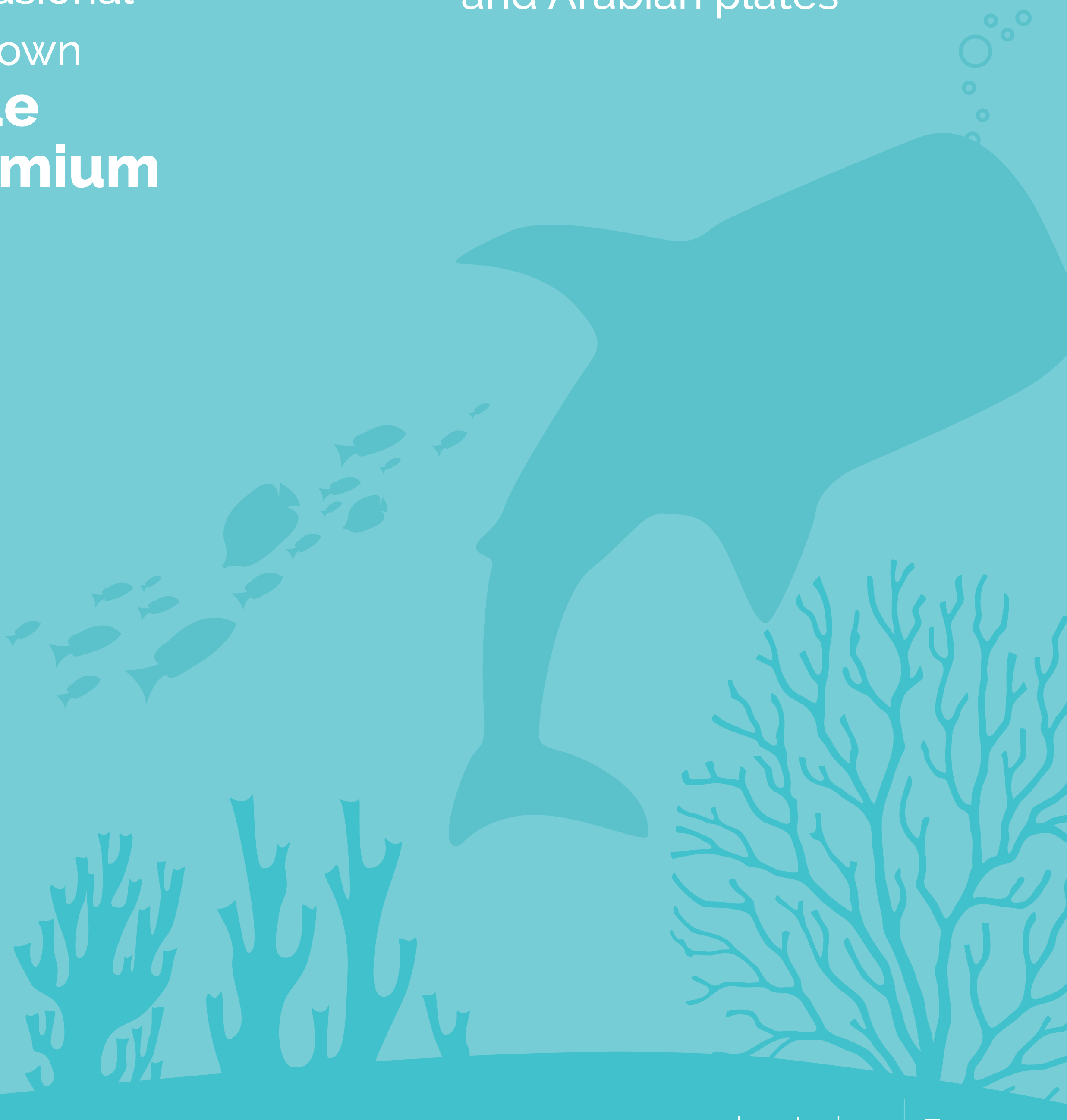
Gets about
1 cm
wider
per year with the
divergence of
the African
and Arabian plates

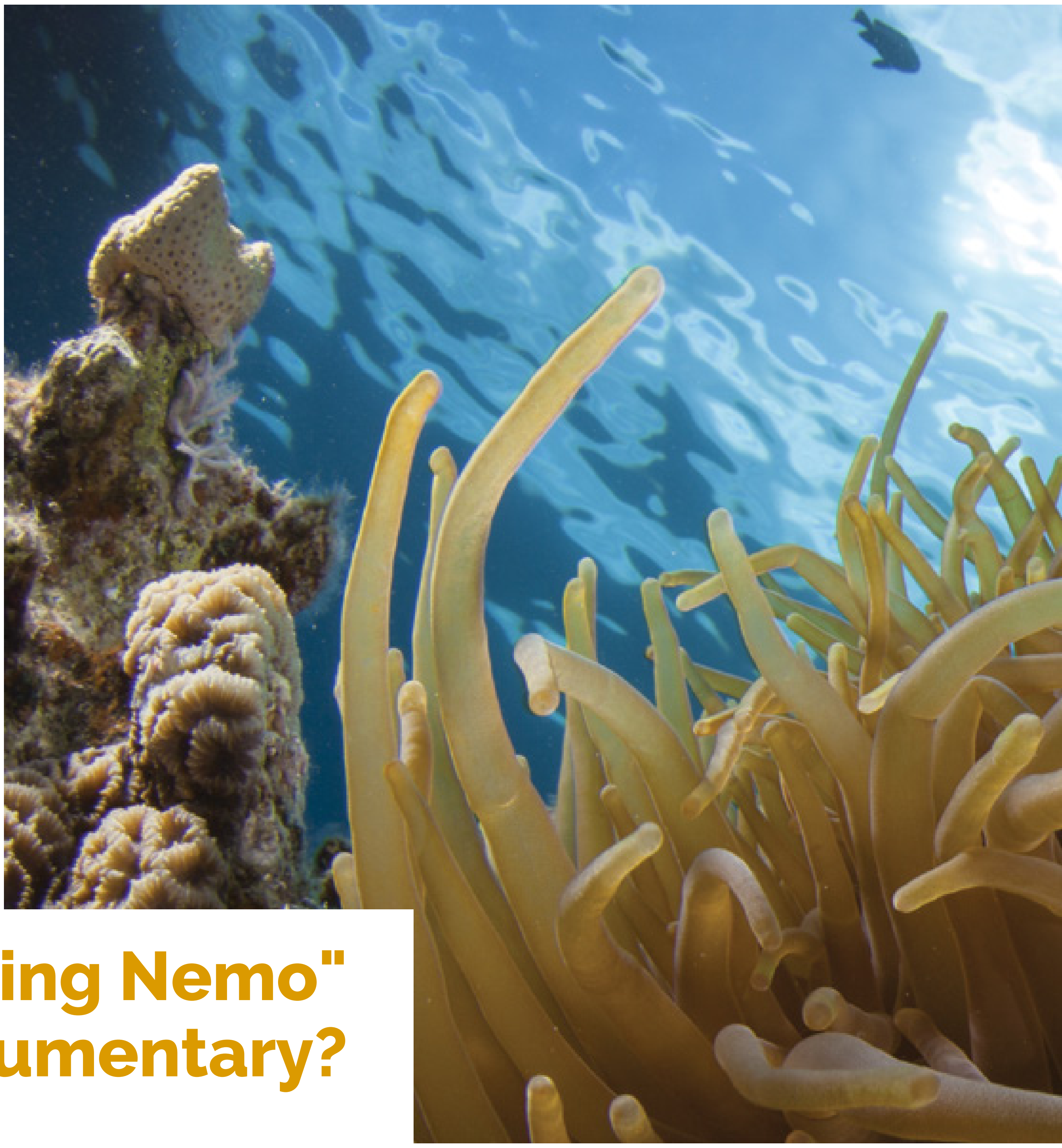


Is named for the occasional blooms of reddish brown cyanobacteria **algae** called **Trichodesmium erythraeum**



Home to around
1,200
species of fish,
10% of which are
found nowhere else





Was "Finding Nemo" a documentary?

The dispersal of fish larvae and the return of juvenile fish to the reef where they were born are important issues for researchers to consider when designing marine reserves.

Research from reefs around the world suggests that most fish tend to settle locally, but a study undertaken by KAUST Associate Professor Michael Berumen and a team of researchers from the Red Sea Research Center (RSRC) suggests otherwise.

The team combined two powerful techniques—genetic parentage analysis and biophysical modeling for larval-dispersion predictions—to examine the population dynamics of the anemonefish Amphiprion bicinctus at the Red Sea's Qita al Girsh reef.

"We were interested in levels of 'self-recruitment' and 'local retention,'" said Berumen. "Self-recruitment is the fraction of new fish arriving at a given site that originally came from parents on that site. This requires intensive sampling, but is relatively easy to measure.

"Local retention is the fraction of a site's total output that returns to the same site," he continued. "This is far more difficult to measure empirically. Total output involves millions of offspring, and to measure local retention accurately, one would need to know the fate of every larva."

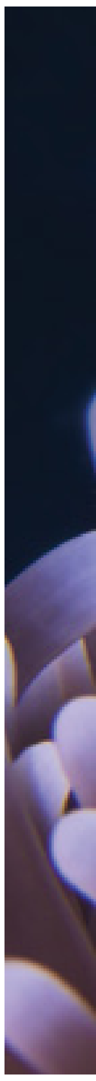
The team estimated self-recruitment using genetic data collected by KAUST post doctoral fellow Gerrit Nanninga and his team of volunteer divers. Using fin clippings, they sampled nearly every potential parent in the Qita al Girsh population. They then collected juvenile fish from a wide area surrounding the reef over two spawning seasons. This enabled the researchers to generate genotypes for each fish to determine parentage.

"Access to KAUST's fantastic lab facilities right next to world-class reefs made this immense task easier," Berumen said.

Associate Professor Ibrahim Hoteit, a co-author on the paper, added, "KAUST's supercomputer also played a vital role in helping us estimate local retention by modeling larvae dispersal patterns."

To the researchers' surprise, of the 348 juveniles collected, only two fish could be assigned to parents at Qita al Girsh. This was confirmed by their model, which also predicted low self-recruitment and local retention in anemonefish at the site. The findings may be explained by patterns of local currents, as well as possible larval behavior traits under certain environmental conditions.

"Our results emphasize the importance of using this combined approach to study more species in more places," said Berumen. "Our findings will be incorporated into recommendations for marine reserves in the Red Sea."●



1-2. A combination of empirical and modeling techniques showed surprisingly low levels of localized settlement in Red Sea anemonefish on the Qita al Girsh reef.

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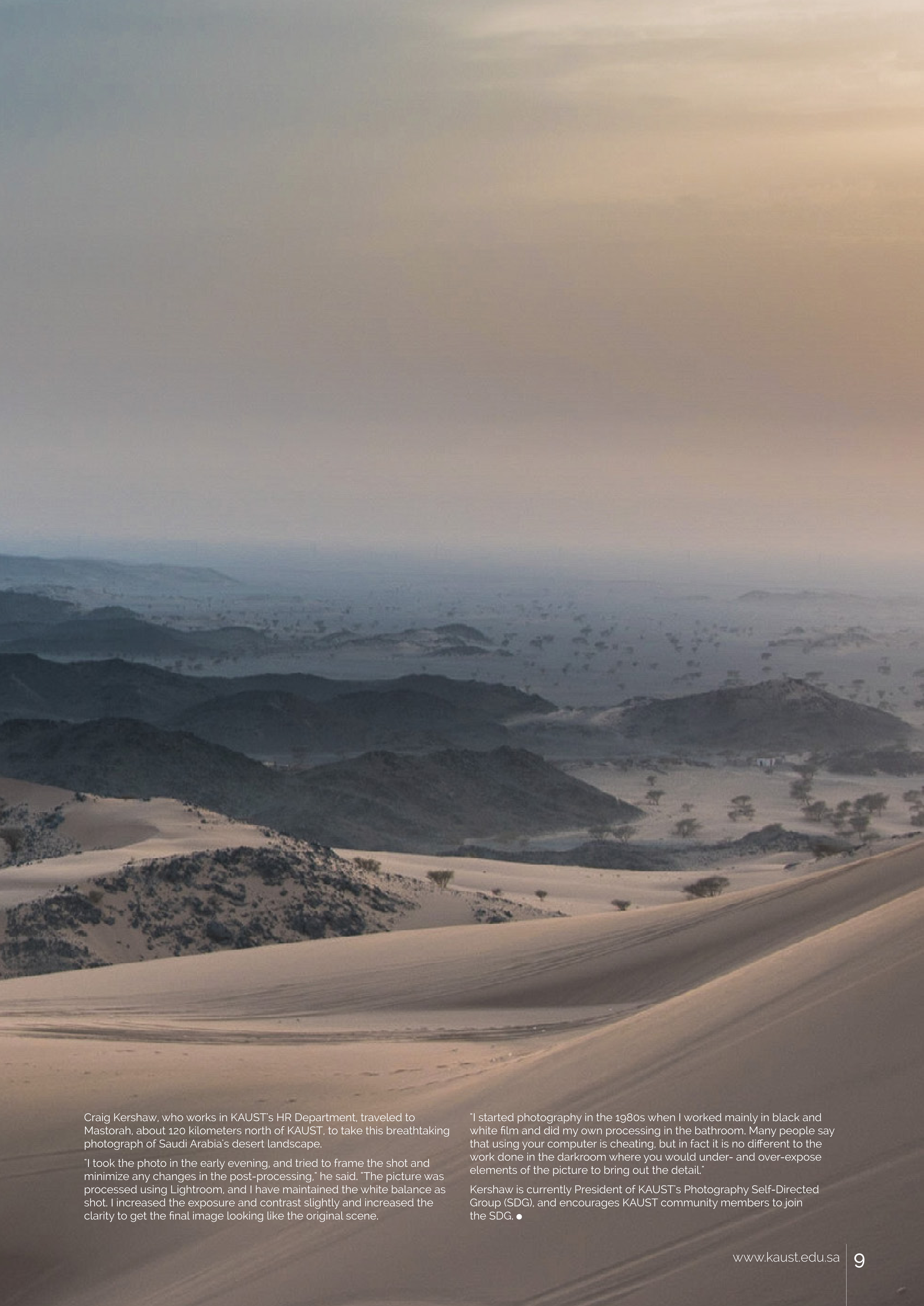
The dunes of Mastorah overlook a chain of volcanic hills that back up to the Red Sea—a backdrop more prominently seen on clear winter days.



Craig Kershaw, who works in KAUST's HR Department, traveled to Mastorah, about 120 kilometers north of KAUST, to take this breathtaking photograph of Saudi Arabia's desert landscape.

"I took the photo in the early evening, and tried to frame the shot and minimize any changes in the post-processing," he said. "The picture was processed using Lightroom, and I have maintained the white balance as shot. I increased the exposure and contrast slightly and increased the clarity to get the final image looking like the original scene.

"I started photography in the 1980s when I worked mainly in black and white film and did my own processing in the bathroom. Many people say that using your computer is cheating, but in fact it is no different to the work done in the darkroom where you would under- and over-expose elements of the picture to bring out the detail."

Kershaw is currently President of KAUST's Photography Self-Directed Group (SDG), and encourages KAUST community members to join the SDG. ●

Ocean's carbon pump reaches new depths

The transfer process of carbon dioxide from the atmosphere to the deep sea is more efficient than previously thought, shows a study of phytoplankton from the open ocean led by KAUST Professor of Marine Science Susana Agusti.

The ocean as a 'carbon sink'

The ocean acts as a "carbon sink," meaning that carbon dioxide from the atmosphere is absorbed by phytoplankton that, when attached to other particles, sink to depths of more than 1,000 meters. Recycling of carbon from these depths back into the atmosphere takes centuries.

This "biological carbon pump" has been studied extensively near coastlines where phytoplankton are abundant. Agusti and a team of collaborators from Spain set out to discover whether the same process occurs in the deep (bathypelagic) waters of the major oceanic basins where plankton are less abundant.

"The information we have about large, remote oceanic areas is limited. Sampling of the deep ocean is difficult and time-consuming, and as a consequence, the bathypelagic waters are still poorly explored," Agusti said.

Joining an expedition

The researchers joined the Malaspina 2010 Circumnavigation Expedition, an interdisciplinary research project led by the Spanish National Research Council that examines the impact of global change on the oceans, and sampled the bathypelagic waters of the Atlantic, Indian and Pacific Oceans at depths of 2,000 to 4,000 meters.

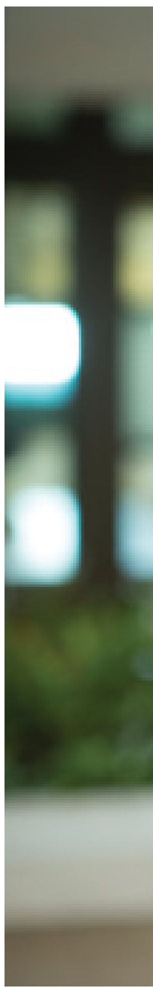
To sample the waters efficiently, the team developed a new oceanographic device called the Bottle-Net, which allowed them to select the depth intervals at which samples were collected. Each deployment and recovery of the sampling system took four hours, with the team then analyzing the collected samples at sea.

Discovering phytoplankton

They found that healthy phytoplankton, which mostly included diatoms, were present at the sampled depths. As phytoplankton require sunlight to produce energy and cannot survive for long at such depths, their presence shows that the biological carbon pump works efficiently throughout the oceans, regardless of the abundance of phytoplankton at the surface.

"We tested the resistance of phytoplankton to the conditions of bathypelagic waters and found that half the population dies every three to 24 days," Agusti explained. "Diatoms that sink simply by gravity would require 1,000 to 5,000 days to reach a depth of 4,000 meters, leaving no chance that any would still be alive."

"Our results demonstrate that the mechanism that removes anthropogenic carbon dioxide into the deep ocean is fast and therefore more efficient than previously believed," she concluded.●



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1. Samples for Dr. Agusti's research were collected aboard the Hesperides research vessel during the Malaspina 2010 circumnavigation. By Lledo / Shutterstock.com.

2. KAUST Professor of Marine Science Susana Agusti from the Biological and Environmental Science and Engineering Division. By Nicholas Demille.

Lessons of **marine animal movement**

By David Murphy

This October, two exciting events for the KAUST community will take us into the ever-changing and always moving world of marine organisms, helping us to learn more about sharks, whales, dolphins and other large animals that populate the Red Sea and the world's oceans.

The KAUST Marine Megafauna Movement Workshop (October 19-20) will feature eminent international speakers who will showcase the latest research on how new sensors, analytics and visualization tools are helping to reveal the collective behavior of large marine animals.

Inspired by the workshop and the work of KAUST's Red Sea Research Center (RSRC), Enrichment in the Fall 2015 (October 16-24) will focus on the theme of the movement of large marine animals, and will feature keynote lectures, aquarium and port trips, marine-themed movies, a musical performance and many other events for the entire KAUST community.

Marine Megafauna Movement Workshop organizer Professor Carlos Duarte and Marie-Laure Boulot, head of enrichment programs, sat down with The Beacon to talk about Enrichment in the Fall and the Marine Megafauna Movement Workshop.

They discussed ongoing efforts to conserve and protect marine wildlife, new tracking technologies for marine species and what we humans can learn from marine animals and their movements.

The Beacon: Describe how the collaboration between your two groups came together.

CD: Large marine animals have always been fascinating to a wide audience, so we capitalized on this for our collaboration. For example, in our community, a popular yearly activity is swimming with the whale sharks in the Red Sea.

How will Enrichment in the Fall and the Marine Megafauna Workshop highlight how KAUST works to conserve marine organisms and the marine ecosystem?

MLB: Sustainability, conservation and preservation are main concerns of ours, as these issues are important for not only the entire KAUST community, but also for the global community. Our events will help raise the awareness of everyone in the community about ocean animals' movements and how to conserve marine organisms. The oceans cover 70% of our planet, and we want to preserve and conserve them to protect the planet's ecology. This is how we hope to educate our students, faculty, staff and community here at KAUST, and also spread this education to the entire Kingdom.

CD: In our projects, we want to use marine animals as our allies – we want to learn about the ocean through them by learning more about how they experience the oceans. The effort to conserve marine animals should be embraced at an international level, and the Kingdom and KAUST can play an important role because the ecology of the Red Sea is still relatively pristine.

Is this a new initiative in the Kingdom?

CD: In Saudi Arabia, there has been very limited research outside of KAUST into the movement of large marine animals. We are drawing from the few people in the Kingdom who are doing this kind of research. Saudi Aramco has had research centered around animal tracking programs, so there will be some delegates from Saudi Aramco attending the conference to tell us how they are helping to conserve these animals. Outside of KAUST, most of the research efforts in this area have come from Saudi Aramco.

Who are some of your other KAUST collaborators for this initiative and for Enrichment in the Fall?

CD: We are also collaborating with the Visualization Lab to make a tracking system available to The KAUST School students and the KAUST community so they can track marine animals on Google Earth and build their own narratives of the animals' journeys. Through this, they will be able to "adopt" and follow an animal, sharing in our fascination about how these animals move through the ocean.

MLB: We will also collaborate with the Library for Enrichment in the Fall; there, we will create an exhibition space for the duration of the program. We will also host our opening night event there, and a special marine-themed Sci-Café event will take place there, as well.

Carlos Duarte
KAUST Professor

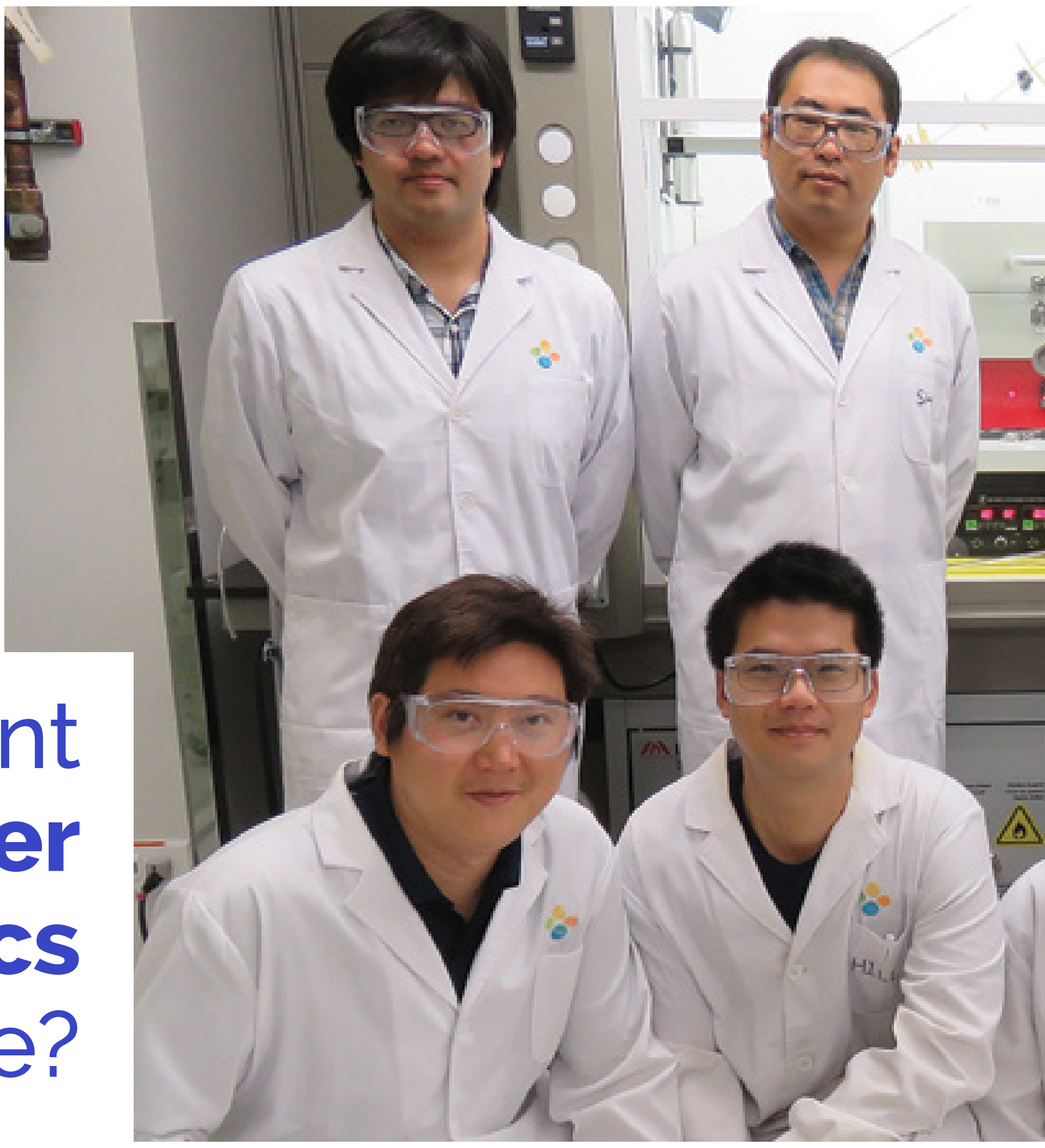
If you could sum up your hopes for the achievements of Enrichment in the Fall, what would you say?

CD: We hope to educate the KAUST community on the threatened status of most marine animals. The health of the global oceans is very complex, but when marine animals are doing poorly, so are the oceans. All marine life is victim to pollution, including pollution with plastic and noise, overfishing and the use of fishing nets and collisions and disturbances from marine industrial operations. For example, the Kingdom produces much plastic that ends up in the Red Sea. There is a lot that can be done here in terms of educating about pollution and public outreach in this area.

MLB: I would be very happy if just one community member – perhaps the next time he or she went diving or snorkeling – could take note of the marine environment and the creatures we share it with. I hope that same person might develop a greater sense of conservation and a bigger picture of the unique beauty of nature and the intelligence of the animal kingdom.

For more information about Enrichment in the Fall 2015, visit fep.kaust.edu.sa.

The Megafauna workshop is organized by Carlos M. Duarte and Xiangliang Zhang, with financial support from the KAUST Office of Sponsored Research. ●



Are transparent **monolayer electronics** the future?

A large glass contraption sits next to Associate Professor Lance Li's office desk. When he arrives at work in the morning, he fills it with water, coffee grounds and ice. By late afternoon, when he really needs a boost, he has an iced coffee waiting for him.

"It's a device I use to reinforce that good results take time," he said.

Li's patience has paid off. In 2012, he embarked on research that led him to come to work in KAUST's Division of Physical Science and Engineering and ultimately publish a seminal paper in Science.

"We don't rush the science," said Li. "We want the best data possible, and we are willing to wait six orz twelve months—however long it takes to get good data from our research partners around the world."

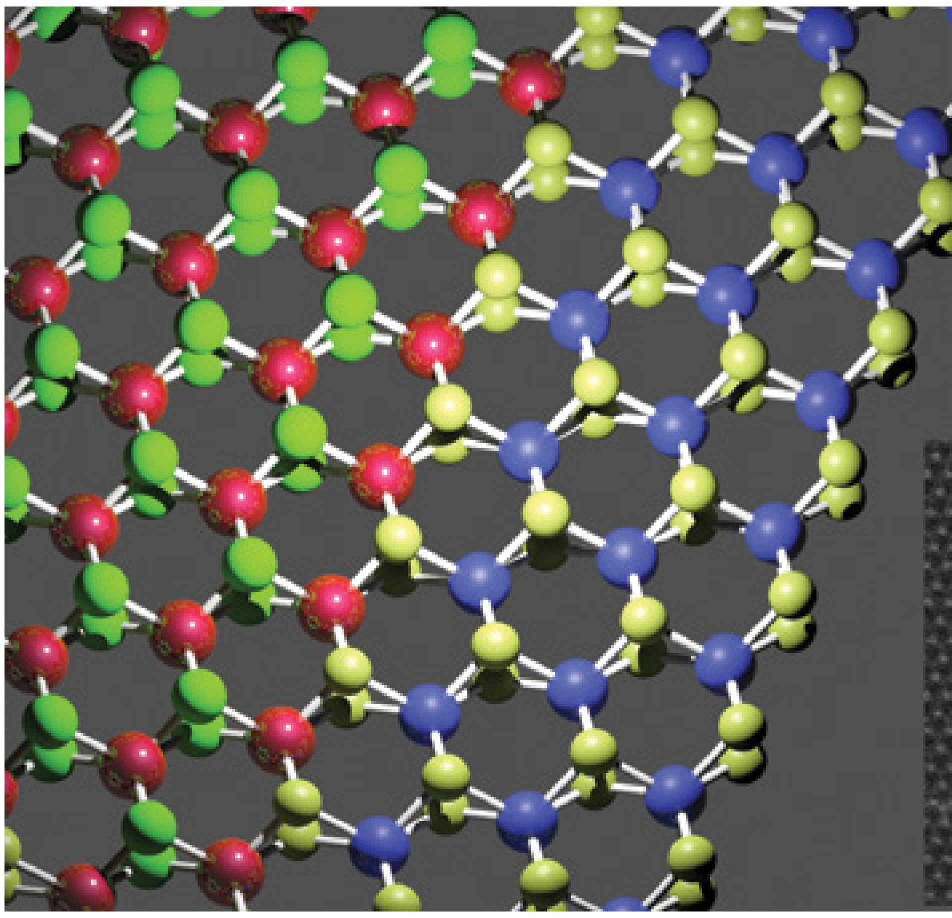
The science

In the Science paper, Li and the research team outline the development of a method to grow atomically thin sheets of semiconductors to be used for two-dimensional (2D) electronic devices.

As silicon transistors approach the point beyond which they cannot be made smaller, alternative materials are needed for future electronic devices. This demand could be met by 2D semiconductor materials, such as graphene or transition metal dichalcogenides (TMD) like WSe2 and MoS2, as these materials have the necessary fast electron transport capabilities and proper thicknesses of the required atomic limit.

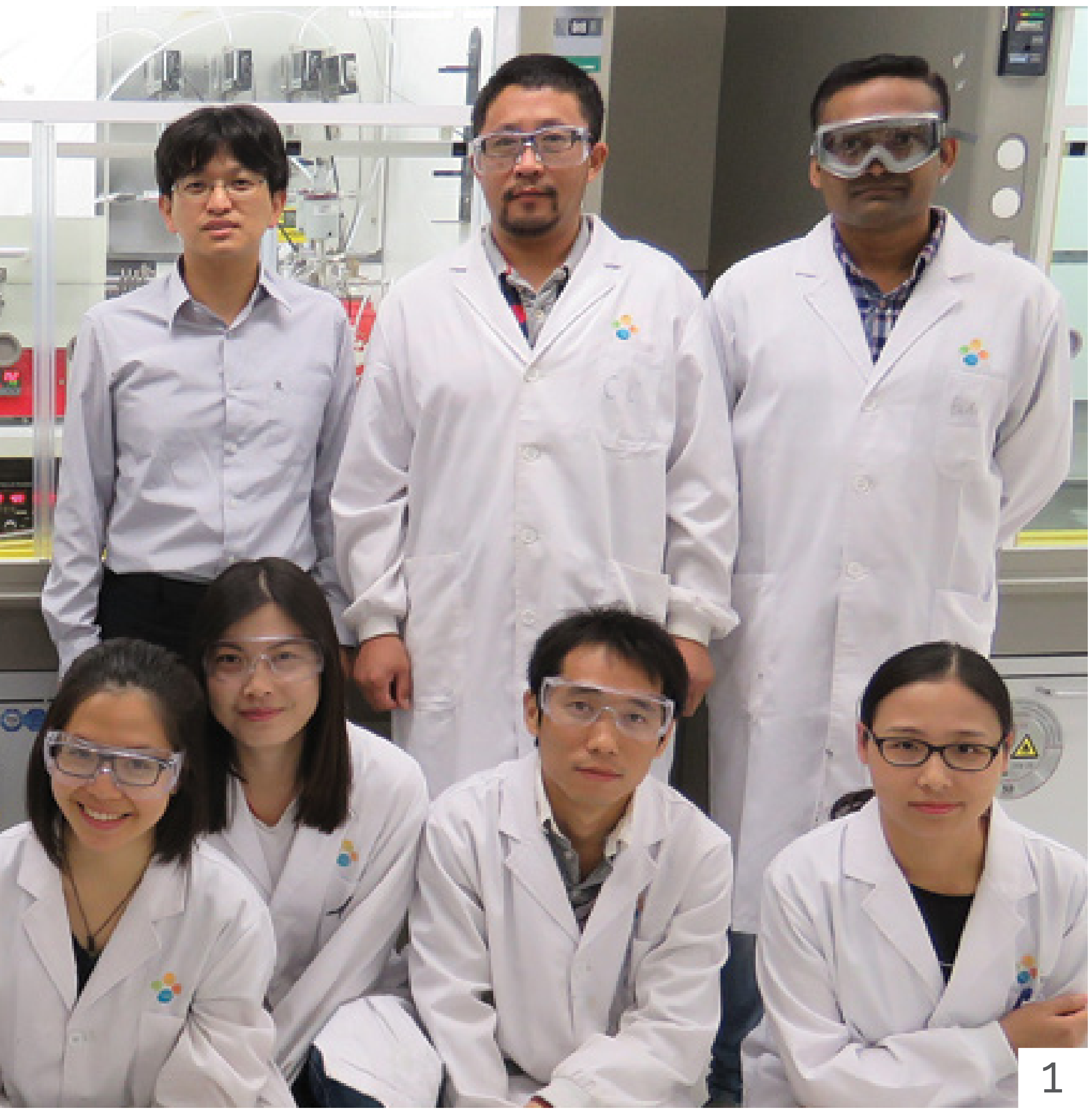
Graphene, however, cannot be turned off, a fundamental issue with its use in transistors, which must have both an on and an off state. 2D TMD materials like MoS2 and WSe2 are more promising, as they are lightweight, flexible and have low power consumption.

Producing advanced electronic devices sheets of just one of these materials is not sufficient, however, as this allows for only limited functionality. More complex devices require the combination of different 2D materials.



"It is fundamentally and technically important to integrate these 2D layers to form devices and circuits in a monolayer lateral plane," Li explained.

Individually, 2D semiconductors can already be fabricated with the right properties. The challenge lies in combining them into complex electronic devices because of difficulties in achieving a perfect interface at the junction where the different materials meet. Any imperfections at the interface may cause losses or inferior electrical or optical properties.



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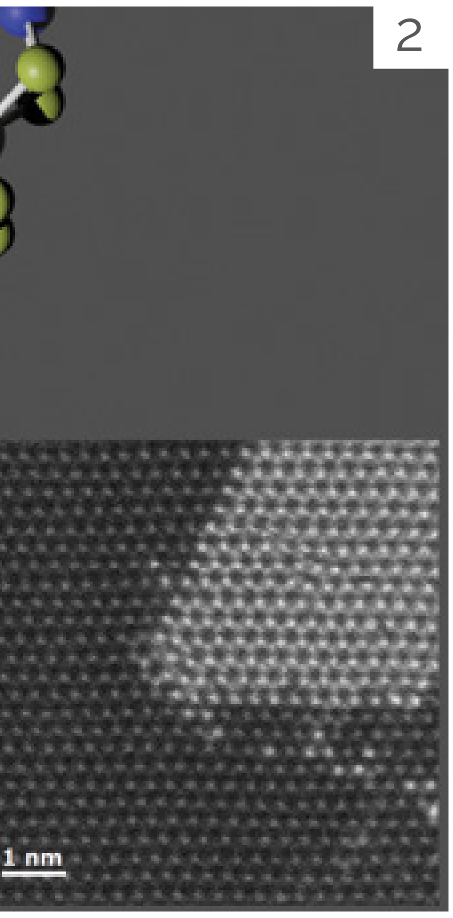

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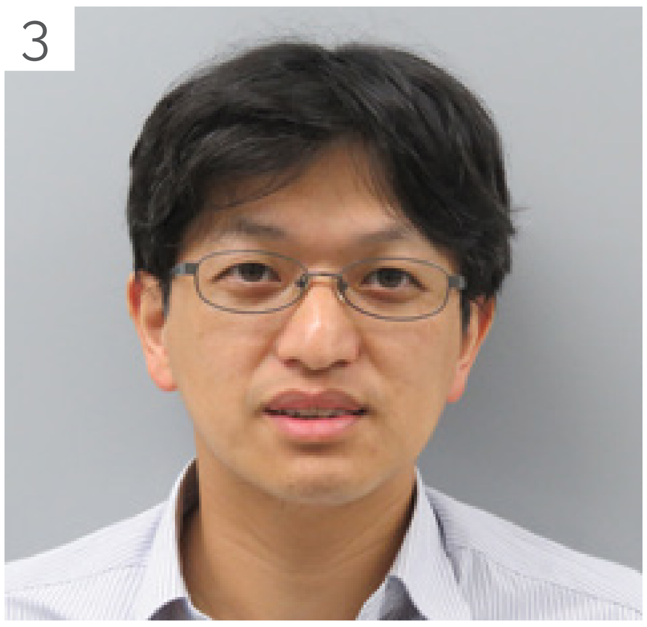

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1. Associate Professor Lance Li (third from left, back row) and his research team in the lab at KAUST.

2. The two-step synthesis of two-dimensional nanosheets. The interface between the WSe2 and MoSe2 sheets is atomically perfect.

3. Associate Professor Lance Li.

The possibilities

The researchers solved this problem by using an optimized two-step growth technique in which 2D sheets were grown from atomic vapor inside a furnace. In the first step, a 2D sheet of WSe2 was fabricated. MoS2 sheets were then grown alongside the first WSe2 layer using a second furnace at lower temperatures suited for MoS2.

The optimized growth procedure resulted in a junction between the two sheets that operates like an electrical diode, opening the door to producing devices as small as several micrometers. The sheets also absorb light, as they are semiconductors, and can operate as photodetectors and solar cells. The team already observed the required photovoltaic effect in the lab.

The future

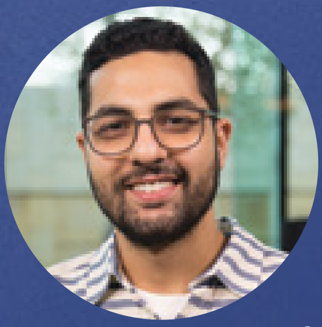
"For now, our research is highly fundamental in scope, and there is still plenty of room for research into 2D semiconductor sheets," Li said.

"We can, however, already dream of ultra-photosensitive materials that are completely transparent and several orders of magnitude higher in efficiency that traditional electronics, particularly photovoltaics and LEDs—materials I like to call 'monolayer electronics.'"

Li noted that upon arrival at KAUST, the dean of his division, Yves Gnanou, worked closely with him to facilitate an immediate start to his research.

"I'm really lucky that I joined KAUST when I did," he said. "I was able to start research work within two months of being on campus, and this work led directly to the Science paper." ●

My University



Ahmed Shibl

Ahmed Shibl, a Ph.D. student in KAUST's Marine Microbial Ecology Lab at the Red Sea Research Center, already had an international upbringing before deciding to study at KAUST. He was born in San Francisco, graduated from an international high school in Riyadh and then attended the American University of Cairo, where he completed a master's degree in biotechnology.

At KAUST, Shibl's advisor is Ulrich Stingl, assistant professor of marine science. Shibl studies the marine microbe Prochlorococcus, but has broad interests in microbiology, genomics and molecular ecology.

"I am currently investigating the diversity and distribution of Prochlorococcus across the environmental gradients of the Red Sea," he explained. "While working on my Ph.D. at KAUST, I have been able to participate in research expeditions to the Mediterranean Sea and Red Sea. KAUST offers almost unlimited benefits to students studying here."

In his spare time, Shibl enjoys exercising and playing football, tennis and squash. He is also a big fan of numismatics, the study or collecting of coins, paper money or medals. "I collect banknotes from all over the world, and I am currently approximately 25 countries short of having collected the entire world's printed banknotes," he said. ●

Where do you read The Beacon?

The Beacon
المنارة
الاحتفال بيوم النبات العالمي لأول مرة في المملكة العربية السعودية
Fascination of Plants Day
debuts in Saudi Arabia

This month's submission comes to us from David Murphy, a writer in KAUST's Marketing Communications Department. David read The Beacon while on a boat touring Vietnam's scenic Hạ Long Bay, a UNESCO World Heritage site and popular tourist destination in the country's northeastern Quảng Ninh Province.

Murphy traveled to Vietnam for seven days in June with his wife while they were on their way to Australia for summer break. Hạ Long Bay was just one destination of many they visited in Vietnam as they made their way from Hanoi to Ho Chi Minh City.

Hạ Long Bay, which literally translates into "where the dragon descends into the sea," covers around 1,553 km2 and is famous for its limestone karsts, tall rock formations rising into the sky. The more than 2,000 formations found in the bay have been shaped by 500 million years of weather and other natural conditions affecting the limestone. Visitors can spend the night on tour boats that take them around the bay, enjoying the natural sites, swimming and kayaking and sampling local cuisine.

"The location was stunning," Murphy said. "It was an area of immense natural beauty surrounded by the spectacular limestone karsts." ●

Capturing **the beauty**

Colin Herrington, a high school student at The KAUST School, charted the September 28 total lunar eclipse in Saudi Arabia's night skies with a series of fantastic time-lapse photos.

The eclipse event, which also featured a blood moon (where the moon turns red), will not be seen again in this combination above Saudi Arabia until 2033.

"This picture was taken from the roof of my house at KAUST," Colin said. "I started a time-lapse at 4:15 a.m. with the interval set to 15 seconds. As the moon progressively became darker throughout the eclipse, I adjusted the exposure so that it remained constant. At around 5:40, the moon had completely disappeared. I then figured out how many photos were needed to create a space in between each phase of the moon (every 16th photo), and then complied them in Photoshop.

"I used a Benro tripod with the Canon 70D and the 24-70f/2.8L II, and used an intervalometer to set the time-lapse."

He noted that he has been an avid photographer for about two years, and "enjoys shooting for personal use, as well as for some business. I am a part of the KAUST Photography Self-Directed Group, and am hoping to do more with it as it develops further. My school is working on forming its own photography club, and I loved being a part of it last year." ●